

Prototype Vent Gas Heat Exchanger for Exploration EVA – Performance & Manufacturing Characteristics

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NASA is developing new portable life support system (PLSS) technologies, which it is demonstrating in an unmanned ground based prototype unit called PLSS 2.0. One set of technologies within the PLSS provides suitable ventilation to an astronaut while on an EVA. A new component within the ventilation gas loop is a liquid-to-gas heat exchanger to transfer excess heat from the gas to the thermal control system's liquid coolant loop. A unique bench top prototype heat exchanger was built and tested for use in PLSS 2.0. The heat exchanger was designed as a counter-flow, compact plate fin type using stainless steel. Its design was based on previous compact heat exchangers manufactured by United Technologies Aerospace Systems, but was half the size of any previous heat exchanger model and one third the size of previous liquid-to-gas heat exchangers.

The prototype heat exchanger was less than 40 cubic inches and weighed 2.6 lb. The water side and gas side pressure drops were 0.8 psid and 0.5 inches of water, respectively. Performance of the heat exchanger at the nominal pressure of 4.1 psia was measured at 94%, while a gas inlet pressure of 25 psia resulted in an effectiveness of 84%. These results compared well with the model, which was scaled for the small size. Modeling of certain phenomena that affect performance, such as flow distribution in the headers was particularly difficult due to the small size of the heat exchanger. Data from the tests has confirmed the correction factors that were used in these parts of the model.